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WEAVING

PART III

INSTRUCTION PAPER

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AMERICAN SCHOOL OF CORRESPONDENCE

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WEAVING.

PART III.

Poor Selvedges and Poor Cloth in General. There is no doubt that a poor selvedge detracts considerably from the value of a piece of cloth, the remark is often made, "Oh that will pass." Not so, there is nothing that looks worse on the counter than a ragged selvedge. It would be surprising to many people to know how much easier it is to sell cloth with a good selvedge than with a poor one. A piece of cloth has been known to pass muster owing to having a good selvedge and yet the body of the cloth has been rough looking through faulty filling. However good the body of the cloth may be, if the selvedge is poor, all looks bad. The sooner the fixers commence to give attention to the making of good salable cloth, the quicker will be the response from the employer to the effect that he recognizes that he has men working for him who are able to think, and plan to turn off the best of cloth and not go about their work in that careless "anything will go" fashion. How is it that there are some mills that have so good a name that a person leaving the place after working there a length of time can work in almost any mill? The reason is, the cloth that is turned out by this mill is first class, and the working people must be in line with such a system or the mill could not have attained the fame it has. There is no reason why any fixer, no matter where he works, should not have the same reputation. If the shed is a trifle too small as the shuttle enters, it has a tendency to twist the outside threads; this defect will make a poor selvedge, also if the shuttle is low at the back as the nose enters the shed, twisted threads will be the result. The wrong timing of the harnesses will cause a poor selvedge. The best time to set the harnesses for almost all cases is to have them level, when the reed is about $1\frac{1}{2}''$ or $1\frac{3}{4}''$ from the cloth on narrow looms. Too large a shed will cause a poor selvedge, as it opens out the yarn too much and

causes the threads to spread out, making an open space between each two. Especially is this shown when a full cop or bobbin is placed on the spindles of the shuttle, and when the filling is near the bottom of the cop or bobbin, the added friction causes the selvedge ends to be drawn in a little, closing up the spaces somewhat between the ends, and a common result from this is that as the yarn passes through the temple, the filling is broken, causing a hole in the selvedge. When there is not sufficient friction on the filling, it is liable to curl up on the selvedge.

The following are a number of ways of inserting friction: The fixing of a small bunch of yarn near the inside end of the eyelet, accomplished by boring a small hole in the shuttle and fixing the bunch of yarn in the hole by a wooden peg. When weaving heavy counts of filling, friction is often added by the use of several stiff bristles. These are fixed to the shuttle, by means of a wooden peg, the hole for the peg being made in the side of the shuttle, so that the bristles will rest on the top of the filling, but near the end. This method can also be used when an extra large cop or extra full bobbin is placed in the shuttle. The pressure of the bristles on the filling prevents it from slipping off in bunches. A baggy shed will cause a poor selvedge, that is a shed where the warp yarn hangs down; and as the filling is laid in the shed, instead of being drawn straight through, it catches on the yarn, and as the pick is beating up the filling curls, makes not only a poor selvedge but a ragged cloth. If the shuttle strikes a little too hard in the box, a poor selvedge is often the result, owing to there being a greater length of filling from shuttle to cloth than there otherwise would be. When adding friction on cop filling, one cannot be too careful, for if the friction is not evenly balanced the filling is generally cut in the selvedge as the cloth passes through the temple, but this will only occur when the filling nears the bottom of the cop, for at this point it lies close to the spindle of the shuttle, and a very little friction is sufficient to make the filling draw off extra tight. The best way at first to add friction to cop filling is to open out the end of the shuttle spindle. This helps to tighten the cop at the nose, and in a number of instances this amount of friction will answer requirements; if it does not, reduce the distance that the spindle

has been spread out and add a little friction to the eyelet of the shuttle, using either a small piece of felt or flannel.

By reducing the spreading out of the spindle, the friction is taken off for the bottom of the cop, which can be run almost without friction, and by adding the piece of flannel or felt, you add the friction for the commencement of the cop, the filling occupying a large space as it draws off, and as the cop is reduced in size the filling clings around the spindle, this in a sense takes off the friction that was added by the insertion of the flannel, so that taking both points into consideration considerable trouble will be saved, besides giving better cloth. Often the temple not being perfectly straight, that is, the face of the temple nearest the reed in the line with the fell of the cloth, causes the filling to be broken in the selvedge threads as the cloth passes through the temple. This is caused by the uneven pulling of the burr with the cloth. An extra large shed and uneven shedding will also cause this defect; and keeping the temple firm will cause the filling to be broken.

It would be well to fix a piece of leather to the front of the lay, so that as the lay comes forward to beat up the filling the leather on the lay will come in contact with the lip of the temple, and force the temple back to about $\frac{1}{8}''$ to $\frac{1}{4}''$. This allows a little yielding of the cloth when the reed is in contact with it. The temple can be forced out too far, and the result desired will not be obtained. If the pin that holds the burr in the temple is rusty, holes in the selvedge will be the result. A badly worn burr will sometimes cause the filling to be broken in the selvedge by not having grip enough on the cloth, and when the reed is beating up the filling the yarn has to be spread out so much to be in line with the reed that the filling is broken, especially if there has been too much friction on the bottom of the cop. It is very seldom that this defect occurs in a full shuttle. Sometimes this defect is caused by a late picked shuttle, but only when nearing the bottom of the cop. This is caused by the extra strain on the selvedge as the shuttle forces its way through the selvedge threads: it draws back the cloth at the same time from under the temple. If the filling catches in the box on the picker, or in any way is held instead of passing clear into the shed, as soon as it becomes loose, it is dragged into the shed, forming a thick place. By watching the loom for a short time, this is very soon remedied.

If the warp has been run on a slasher that has had a narrow press roll, however slight it might have been, poor selvedge will be the result; the portion that the press roll does not touch is more loose and occupies a large circumference on the beam, and as the warp is drawn off the threads become slack, and a good selvedge cannot be made with slack yarn. If a warp has been made and the tension has been changed on the spools, it is liable to cause kinky filling, and sometimes when cotton yarn is run with the woolen yarn, if there has been too much friction on the cotton spools, kinky filling will be the result. Woolen yarn stretches more than cotton yarn, and allowance must be made. Whatever kind of warps are being made, if there is more than one kind of yarn in the warp, due allowance must be made for the difference in the stretch of the yarns.

When backed cloths are made and the warp is on one beam, it often happens that the yarn forming the backing cloth becomes loose. To overcome this fault the whip-roll has often to be changed. Raising the whip-roll will make the bottom shed tight and the top shed loose; lowering the roll will have the opposite effect. Closing the shed a trifle earlier will often cure kinky filling, but care must be taken as a return result may be kinky warp yarn, especially if there is a sudden change from a light to heavy lift of harness. If the filling is clear and the warp alone is kinking, often by the changing of the whip-roll, adjusting the weight, and having a late shed, the kinks can be overcome. If the feelers get down in the lay too soon or they rest very heavily on the filling, kinks will result. By adding a small amount of weight to the feeler base, this will be remedied. Often by placing a piece of wire in the feeler slot, so that it will come up between the feelers, kinky filling will be prevented. If filling or warp is kinky, and the shed is being changed to overcome the fault, due consideration must be given to the pattern that is being woven, and the timing of the boxes, for if the whole shell is changed, the timing of the boxes will be changed, and the change being made without thought has been the cause of many breaks. The pattern also makes a difference. If there is a sudden change from a light to a heavy lift of warp, the shed will not close as soon as when even sheds are being lifted, that is, the heavy lift and the light

lift coming together will not have the effect of holding the filling as tight as an even shed will, not until the harnesses have passed each other. The great causes of kinky filling are uneven or too strong a pick, or poor tension on the filling in the shuttle.

Filling Breaking. Bobbins Breaking.

Spindle too small for the cop tube.
Pick too strong.
Loose binder.
Rebounding shuttle.
Boxes too high or too low.
Over and underfaced reed.
Crooked running shuttle.
Worn shuttle.
Bottom shed high off the race-plate.
Temple too high.
Loose crank-arms.
Soft spun bobbins.

Filling Breaking. There is a distinctive difference between filling breaking and filling being cut, or cutting filling. The term "breaking" means if using cop filling, the cop will break on the spindle and will come off in a bunch, and if not caught in time will cause a break; the same with the bobbin, the filling comes off in bunches. With cops there are two or three causes for this. The tube on which the cop is spun may be too large for the shuttle spindle. This can often be overcome by opening out the shuttle spindle at the back, inserting a small piece of leather or tube, but at the same time remember the fact that you can open the spindle out too far, so that when the cop filling has run off near to the bottom, there will be too much drag on the yarn, and the filling will be constantly breaking. This point is often overlooked and it is the cause of a great amount of waste, for in the endeavor to draw the cop down the spindle, when it is three-quarters woven off, the rest of the cop is spoiled and becomes waste. It hardly seems possible sometimes that the cop can be too tight on the spindle, but it can. As a proof of this, how often one sees a weaver when the filling has almost run out, and it has broken, instead of drawing the cop bottom off the spindle, the tube has to be cut off, and when this is done, it must have been stretched considerably, and at the same time the filling has had all the

nature stretched out of it. Sometimes fixers have worked on a loom for what they thought was the filling cut, whereas it was the spindle that was opened out, without due thought for the reason. The filling breaking can be remedied by opening out the point end of the shuttle spindle. If opened too far, it will certainly help to break the filling. For example, suppose the spindle has been opened too far, and the filling has broken, draw down the remainder of the cop nearer to the spindle point, and in nine out of every ten cases, the filling will run off all right. This then shows that there is added strain on the yarn under such circumstances.

Filling can be prevented from breaking off at the shoulder whether cop or bobbin, by the use of a few stiff bristles. These can be inserted in the same manner, as explained, in adding tension to the filling. If the filling breaks lower down than the shoulder on the cop or bobbin, in the majority of cases it is because the pick is too heavy, or possibly the boxes are not tight enough. If it is possible to take off a little pick, by all means do it, for any practical man knows that the reducing of the power of the pick is economy in supplies and labor. If the boxes are not tight enough it is an easy matter to close them in, but be governed by understanding the reason why, because if the box is made the least bit tighter than necessary, when starting up the speed after being stopped for noon hour, or over night, in all probability the loom will bang off. Tighten the box as little as possible. Sometimes the breaking of the filling can be overcome by the alteration of the check spring at the end of the box, so that it will offer a greater resistance to the shuttle. The following question was asked in an examination in Weaving, and the answer to the question may possibly be beneficial to some one:

Supposing you received a quantity of cop filling, the cops being longer than the previous ones that were used, covering almost the entire length of the shuttle spindle, and there is a tendency for this filling to break off, what means would you employ to overcome this difficulty with the least amount of waste, the shuttle being the standard size for the mill, and the spindle being of regulation length? This is the answer: Press down the cop on the spindle as firmly as possible, taking care not to twist it,

take off a little pick, then the shuttle naturally requires less resistance when entering the box, so that by loosening the spring on the binder, the shuttle will enter into the box more freely, yet not with sufficient power to break the filling. Adjust the check spring if necessary, and add a few bristles to the shuttle. This has actually been tried and proved to be all right.

The bobbins in the shuttle are more often split through the shuttle striking the top of the box than from any other cause. The cause may be the bottom shed off the race-plate, boxes changing too soon, or a crooked running shuttle. If the bobbin fits tightly on the spindle and the pick is too strong, broken bobbins will sometimes be the result. The box a trifle low and a small shed or late shed is a cause of shuttle turning; also temple too high.

Filling Being Cut.

Poor shaped swells.
Pick too strong.
Flat faced shuttle.
Sharp eyelet in shuttle.
Flat shuttle.
Box entrance too narrow.
Sharp edges on groove in swell.
Loose picker collar.
Worn projection on picking stand.
Wrong setting of the temples.
Sharp dents in the reed.
Sharp filling fork and grate.
Feelers too heavy for tender filling.
Wrong timing of the filling motion.
Fork resting on the bottom of the lay.
Uneven yarn.
Threads clinging in the shed.
Wrong timing of shed.
Uneven shedding.
Crooked running shuttle.

Cutting Filling. This work often causes a great amount of trouble, especially when mispicks are made either in plain or fancy cloths, particularly in fancy cloths. Take for instance on a leno pattern, and the mispick is towards the center of the cloth, the

sides of the cloth being all right, if this should happen at the crossing pick the pattern is spoiled. The cause of this will be explained later. The causes of filling being cut are numerous. A prevention for the filling being cut in a general sense is a well shaped swell. A bow shaped swell is of no value in any case, for as explained in the fixing of the pick, it requires a great amount of power to drive a shuttle in a box with a bow or blunt shaped swell attached to it, and why some loom makers persist in making these swells is unaccountable. They do, however, and the shuttle has not run half a day before the face around the eyelet has been worn flat, and this is one of the many causes of the filling being cut. The eyelet will become sharp, and then the best method to pursue in repairing it is to make the eyelet smooth with a piece of emery, and drive the eyelet a little further into the shuttle. This will allow the groove in the shuttle to be made a little deeper, which is an essential point in the running of a shuttle.

The blunt shape will not only wear off the groove in the shuttle, but will also cause the shuttle face to chip, and this is often the cause of the filling being cut, besides sometimes cutting the warp threads. If the groove in the face of the shuttle is worn, the filling will most certainly be cut. This causes the filling to be pressed against the swell or the front end of the box and as the shuttle passes in, it will be cut. It is an easy matter to file a deeper and wider groove or have the carpenter plane a groove in the shuttle. A flat shuttle has been known to cut the filling, especially when the groove on the bottom of the shuttle is worn. This is another reason why it is best to elevate the back of the shuttle a little; if it is not elevated, it will rub on the filling as the shuttle passes out of the box. A shuttle that rises slightly in the box, especially if the edges of the groove in the swell are a little sharp, or when using a flat faced swell, the rising shuttle will often cause filling to be cut.

One of the best remedies is to take the swell from the box, place it in the vice and bend it over a little at the top, a very little is sufficient and in the majority of cases this rule will be found to give the desired result; not only does it keep the shuttle down but it prevents the cutting of the filling because the face of the shuttle is clear from the swell. The entrance of the box can be

filed a little at the bottom and this will materially assist in the prevention and it is far preferable to attaching a strip of leather, for the leather soon looks dirty, besides blackening the filling if care is not taken. A small piece of leather can be placed behind the swell at the top, near where it is bolted to the loose part of the box, but it is preferable to bend the swell, for then it is permanent. This will also prevent the soiling of the filling, which when woven in the cloth is hard to wash out. If the entrance of the box is too narrow, a common result is the filling being cut, or the filling becomes soiled at this point, after the shuttle has been run a short time. The least distance that should be allowed extra for the entrance of a box is $\frac{1}{4}''$ wider than the shuttle and it does no harm to have it wider still than this; for by having it so, a better range can be obtained for the shuttle, and better results in every way. If the temple is too low on the race-plate, as the lay comes forward, the filling that is on the plate gets underneath and is cut.

Sometimes the filling is not cut clean, but just hangs together and as soon as the strain of drawing off the cop or bobbin is felt, it breaks, and in all probability the end that is hanging outside the shuttle will catch in the shed at the other side of the cloth, and consequently the loom does not stop and there is a mispick in the body of the cloth. This is often mistaken for a harness missing, but if examined closely it will be found that the filling is cut. The temple being too close to the reed will cause the filling to be cut as readily as the temple being too low on the race-plate, especially is this shown in a loom where almost all the full reed space is used. As the lay is on the front center, the filling is drawn against the temple and consequently in a good many instances it is either partly cut, or cut altogether, and if only partly cut, then mispicks are often the result. This is also another reason why it is advisable to have the lay press back the temple a little. If the grate is sharp, or a groove is worn on the face by the constant working of the loom, occasionally the filling will be cut, but in a number of looms the grate is now being placed back a trifle, for the purpose of preventing the shuttle from rubbing against the face of the grate, and in this way gradually making the edges sharp. If the filling fork passes too far through the grate, there is the possibility of having the filling cut occasionally and especially so if the bottom

of the fork touches the lay, when it should be freely pressed back by the filling. There is no need of having the filling fork pass through the grate any more than is necessary to just raise up the

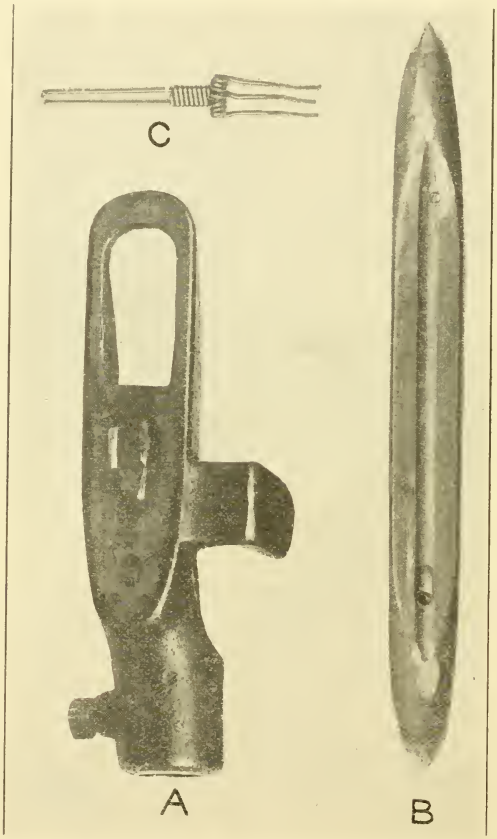

Fig. 136. Worn Parts of Loom Causing Filling to be Cut.

fork from the catch of the elbow lever, when the loom is turned over by hand: because when the loom is running, the filling over the grate coming in contact with the fork at a quicker speed, there

will be sufficient clearance given to the fork. By all means have the bottom of the fork clear the lay. Sometimes the filling will be cut by the wrong timing of the elbow lever, that is, the lever moves too soon so that the filling must force the hook of the fork off the catch of the elbow lever.

It will sometimes happen that one or two of the dents of the reed have become sharp through a faulty place on the shuttle, and when these come in contact with the filling when beating up the last pick, the filling will be cut, especially if there has been considerable friction on it. Of course, this defect will often cut the warp threads, but sometimes it will not, and yet will cut the filling if the temple has been touching the reed. The face of the dents become flat and sharp, and will often cut the filling in the selvedge. If not worn too much, the reed can be remedied in the loom by using a little flour of emery and a flat piece of hard wood, rubbing the edge of the wood on the dents; it is best to add a little oil to the emery, which gives it the form of a paste, so that it can then be used to better advantage. If the shuttles run crooked across the lay and strike the front of the box, cut filling is often the result, especially at the side where the eyelet of the shuttle enters first. The remedies for this have been given. If the rollers in the spinning frame have been dented a little, the result will be uneven yarn. Some parts do not have strength enough to resist the drag as it is placed in the shed and no amount of loom fixing will cure this. Threads clinging in the shed will cut filling. These are often called by the name of twitty places, or stitches and in a heavy warp, especially of worsted, this fault will generally occur. An early and small shed is often the cause; also badly sized and beardy yarn. A little French chalk or wax on the back of the warp will help to overcome the latter. Sometimes even though the warp threads do not cling together, a shed that is very early will cut tender filling.

Explanation of Fig. 136.

A. Worn projection on picking stand.

B. Worn shuttle caused by loose binder bolt.

C. Worn fork.

Loom Stopping, or Failing to Stop When it Should.

Crooked running shuttle.
Wrong timing of the stop motion.
Worn rocker shaft and bearing.
Rebounding shuttle.
Wrong setting of the stop motion.
Dagger rubbing the receiver plate.
Bent connecting rod.
Worn lock lever.
Waste in feeler slot.
Bent feelers.
Late pick.
Feelers too low in the shed.
Rebounding dagger.

If the dagger is worn it will rebound over the catch finger; the dagger should be filed square. If the feelers are bent, they will not drop low enough in the feeler slot, and the dagger passes the receiver. Sometimes the feelers work out a little and catch on the rib of the reed, and the loom will continue to run; or the paper comes loose from the rib of the reed, or if waste is allowed to accumulate in the slot, or occasionally a thread, and remains in the reed, all cause the above result. A late pick will cause the feelers to bend, especially if they are low in the shed. A crooked running shuttle often caused by a worn picker-stick will bend the feelers. If the edge of the lock lever is worn, the shipper will slip off. Sometimes the rod that holds up the slide will become bent, and cause the slide to cover the receiver. The timing of the motions is given in the chapter on filling stop motion. A crooked running shuttle in the majority of cases is the cause of this.

If the shuttle does not enter the box straight, the back end of the shuttle strikes the fork and causes it to rebound, and in the rebound it catches to the end of the elbow lever, and even if the rebound is not perceptible, it is often sufficient for the fork to come in contact with the filling and to cause a little more to be drawn from the shuttle, the filling, consequently, does not tighten enough to raise up the fork. If the shuttle is a little late, the same result will follow, and if the shuttle rebounds a little this will cause the filling to be slack, and the fork cannot be raised up by slack filling and sometimes the filling will drop down below

the fork, owing to either being too slack, or the fork fixed a little too high. Occasionally the filling will loop on the fork, and as the cloth is woven down the fork is caused to swing by the loop of filling, and therefore will often catch on the elbow lever. The looping of the filling on the fork is caused by a rebounding shuttle, too little friction on the filling, one of the prongs of the fork not being level with the rest, or the sliding of the filling down the face of the fork as it is passing through the grate, and also if the fork passes too far through the grate, causing it to be raised too high, so that it rebounds and catches on the filling as the shuttle is passing. It will be noticed by examining this particular point that the filling curls, owing to it being allowed to go slack, and if

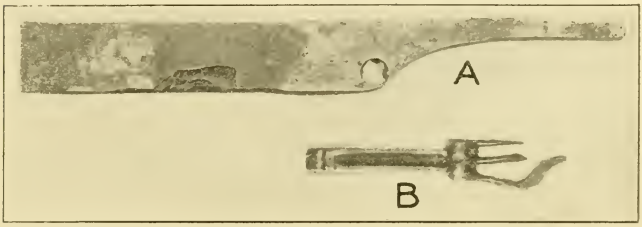

Fig. 137. Worn Parts of Loom Causing Failure to Stop.

the curl happens to drop down toward the sole of the lay, when the fork is fixed as before stated, the defect spoken of will ensue. If the filling is sliding down the fork, it is advisable to dent the prongs a little, but not so that they will cut the filling, just sufficiently to retain the filling. It can also be overcome by having the prongs of the fork straight down from the bend, with a little bend at the extreme end of the fork. One is not always able to fix the fork in this way, owing to the length of the hook in comparison to the way it is fixed to the slide, but so far as this rule can be carried out, it is best, because it not only looks better, but better results follow. When the prongs are pointing out at the bottom it gives the filling a chance to slide up, besides allowing it to pass farther through the grate to raise high enough, and also the point will touch the sole of the lay. If the prongs of the fork are straight down, they pass back a little, whereas the others pass down. An occasional cause for the loom stopping is that the

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bearing for the rocker shaft becomes loose; this allows the lay to jump when running, and therefore when the power is off and all seems to be right, it is well to examine these points.

Explanation of Fig. 137.

A. Worn projection receiver.

B. Bent fork.

Wrong Timing of the Stop Motion. It is best to set the cam to move the elbow lever as the crank is passing close to the front center. It is when running two widely different counts of filling that the greatest difficulty is met. For instance, 13's and 90's filling, if you raise the fork the least bit too high with the fine counts you are certain to have trouble with the coarser counts. Have as little friction as possible on the coarser counts, and raise the fork by the finer filling so that it will not quite clear the catch of the lever when the loom is turned over by the hand. In the majority of cases this will give the desired results; if not, then raise the fork a little higher by the fine filling, and add a thin piece of wire to the slide in the form of a bridge, to prevent the rebound of the fork when the coarse filling is being woven, but have the wire loose a little so that as the fork strikes it, the wire will yield a little. Another way would be to scrape the coarse filling shuttle a little so that it will go into the box more easily, but to prevent this from breaking off the filling or spoiling the picker, arrange the check spring to give the resistance required. A source of annoyance, and which is often misleading, is the ticking or occasional rubbing of the dagger against the receiver plate. This gradually pushes off the shipper rod. The main cause for it is that the box is not tight enough, or if it is, the swell is of poor shape.

When using a flat swell that is bolted to the loose portion of the box front, the cause may possibly be that the back end of the swell is bent too far back. Take the shuttle out of the box and notice when the dagger point strikes the receiving plate. It may possibly be striking too high; if it is, this can be altered by the fingers on the dagger rod; loosen them, and have the point of the dagger in the hollow of the receiver; drive on one finger and test it to see if the dagger is right, then drive on the other. When doing this the finger that is set sometimes springs back while

driving the other finger on the rod, and it would be well, therefore, to place a tube or some thin substance between the fixed finger and the swell; then fix the other finger, and it will be found that they are both about equal in the end. The loom will sometimes stop because the stand for the shipper handle, or the shipper handle itself, is worn, and this allows the shipper handle to slide off. It is easily remedied however.

WEAVE ROOM CALCULATIONS.

The calculations in this section will not include those necessary for the construction of cloth; but give all that may be necessary in the routine work of the Overseer, and possibly the Superintendent.

All yarns have a base, foundation and standard number; and this standard must be well known before correct calculations can be made.

The term counts or numbers has the same meaning and determines the number of yards in one pound of the given thread. All yarns with the exception of raw silk are finer of thread as the counts or numbers go higher. There are 7,000 grains in 1 pound avoirdupois: 437.5 grains in 1 ounce.

840	yds.	constitute	1 lb.	of	1	counts of cotton yarn.
1600	"	"	"	"	"	1 run woolen yarn.
300	"	"	"	"	"	1 cut woolen yarn.
560	"	"	"	"	"	1 counts worsted yarn.
840	"	"	"	"	"	1 " spun silk.
300	"	"	"	"	"	1 " linen yarn.

Raw silk is generally reckoned by the number of drams that 1,000 yards weigh, using as a base 1,000 yards to one dram of silk, 256,000 yards to 1 pound of 1 dram silk, there being 256 drams in 1 pound. Owing to the difference of opinions among experts as to what constitutes a denier, we prefer to calculate by the dram system.

On all yarns except raw silk, to find the number of yards in 1 pound of a given counts of yarn multiply the standard by the given number.

COTTON YARNS.

There are 29,400 yards in 1 pound of 35's cotton $840 \times 35 = 29{,}400$. For greater convenience when dealing with small quantities, one lea or 120 yards is weighed; the 120 is $\frac{1}{7}$ of 840, 1,000 grains or $\frac{1}{7}$ of a pound is also used in the calculations.

If very small quantities are being weighed, a smaller division than $\frac{1}{7}$ can be used, but the standard number of yards (840) and the number of grains in 1 pound (7,000) must be divided by the same number. Rule: divide the standard number of yards, and the number of grains in 1 pound by any number that will give a working basis: then weigh that number of yards and the resultant weight in grains divided by the working basis, will give the counts of yarn in question.

Examples —

120 yds. weigh 20 grs., what is the counts?
$1{,}000 \div 20 = 50$ counts.

120 yds. weigh 30 grs., what is the counts?
$1{,}000 \div 30 = 33\frac{1}{3}$ counts.

60 yds. weigh $12\frac{1}{2}$ grs., what is the counts?
$500 \div 12.5 = 40$ counts.

30 yds. weigh $3\frac{1}{2}$ grs., what is the counts?
$250 \div 3.5 = 71\frac{1}{2}$.

Suppose we have only one-half yard of yarn and we wish to know the counts; following out the previous method of reduction to find a basis, we have the following:

7,000 grs. = 1 lb. 840 yds. are in 1 lb. of 1's counts
or 1,680 half yds. $7{,}000 \div 1{,}680 = 4.166$ grs.

That is one-half yard of 1's counts will weigh 4.166 grains. This is a standard. Weigh half the yard of unknown count and divide the resulting weight by the standard. The quotient will be the counts of yarn.

$\frac{1}{2}$ yd. weighs $\frac{1}{4}$ of a gr. $4.166 \div .25 = 16.6$ counts.
$\frac{1}{2}$ yd. weighs $\frac{1}{10}$ of a gr. $4.163 \div .1 = 41.6$ counts.

Twisted and ply yarns are denoted as follows: $\frac{2}{10}$'s, $\frac{3}{32}$'s, $\frac{2}{60}$'s, $\frac{6}{30}$'s, and in all yarns with the exception of silk the top figures denote the number of single threads of the given number of counts; the lower figures denote the counts of the single yarn. Cabled

yarns are two or more ply yarns twisted together, and are described as $\frac{4}{2}$ $\frac{}{60}$'s, or 8 ends of single 60's.

Although ply threads are slightly heavier than the same number of yards of the single threads before they are twisted (caused by the increased contraction), it is customary when two or more threads of equal counts are twisted, to divide the counts of the single yarn by the number of threads twisted together, and the result is equivalent to a given single yarn: $\frac{2}{30} = 30 \div 2 =$ 15's counts. $\frac{3}{75} = 75 \div 3 = 25$'s counts. $4\ \frac{2}{60}$'s $= 60 \div (4 \times 2)$ $= 7.5$ counts.

When two or more threads of unequal counts are twisted together, the following is the rule by which to calculate the counts of the combined threads.

Rule. Divide the highest by itself, and by the other counts; add the sum of the quotient of each division and divide the highest counts by the sum, the result is the counts of the combined threads.

What are the counts of the following:

20's and 30's $30 \div 2\frac{1}{2} = 12$ 12's counts.
40's and 35's $40 \div 2.14 = 18.7$ 18.7's counts. Ans.

What are the counts of the combined threads? 30's, 25's and 20's $= 30 \div 3.7 = 8.1$ counts.

WOOLEN YARNS.

The "run" system is the most common method of calculating the counts of woolen yarns. There being 1,600 yards to 1 pound of run yarn, how many yards are there in 1 pound of $4\frac{1}{2}$-run yarn?

$$1{,}600 \times 4.25 = 6{,}800 \text{ yds.}$$

There are 56 pounds of woolen yarn, what is the run and length of the same?

One yard of 1-run woolen weighs 4.375 grains. We weigh 50 yards of this quantity and it weighs $43\frac{3}{4}$ grains.

$$218.75 \div 43.75 = 5 \text{ run yarn.}$$
$$1{,}600 \times 5 \times 56 = 448{,}000 \text{ yds. of yarn.}$$

When calculating for the cut system proceed in the same manner, but substitute for the cut standard 300 yards.

WORSTED YARNS.

How many yards are there in 1 pound of 30's worsted?

$$560 \times 30 = 16{,}800 \text{ yds.}$$

We have 16,800 yards of 40's worsted, what is the weight?

First find the number of yards in 1 pound of 40's, then proceed.

$$560 \times 40 = 22{,}400.$$
$$16{,}800 \times 16 = 268{,}800. \quad 268{,}800 \div 22{,}400 = 12 \text{ oz. of yarn.}$$

We know that one yard of 1's counts of worsted weighs 12.5 grains; if 3 yards weigh $1\frac{1}{4}$ grains what is the counts? Divide the base for worsted by the yards weighed to get the working number of grains and yards.

$$560 \div 3 = 186.7. \quad 7{,}000 \div 186.7 = 37.5 \text{ grs.}$$
$$37.5 \div 1.25 = 30 \text{ counts of yarn.}$$

Three yards is $\frac{1}{186.7}$ of 560 yards. 37.5 grains is $\frac{1}{186.7}$ of 7,000 grains.

SILK RAW.

There is a distinctive difference between spun and raw or reeled silk.

Spun silk is made from waste silk and the poorer qualities of cocoons, and the fibre passes through similar processes to cotton before it is made into yarn. Raw silk means silk that is reeled from the cocoon, the strands of silk are then doubled and twisted to make tram or organzine, the former for filling, the latter for warp.

Tusser or Tusseh silk, is a raw silk from the wild silk worm of India.

There are two distinct standards for determining the counts or sizes of raw silk yarns: Denier and Dram. A hank of 520 yards is used as a base, and the number of deniers such a hank weighs, denotes the counts or size of the yarn. $533\frac{1}{3}$ deniers equals 1 ounce avoirdupois.

When using the dram as the standard of calculation, the counts required of the silk reeled is the number of drams 1,000 yards weighs.

If 1,000 yards weigh $6\frac{1}{4}$ it will be $6\frac{1}{4}$ dram silk. The number of yards in 1 pound of $6\frac{1}{4}$ dram silk is found as follows:

$1,000 \times 16 \times 16 = 256,000$ yards in 1 pound of dram silk. As stated the higher the numbers the less number of yards in 1 pound of run silk; so that dividing the base by the weight of 1,000 yards in drams will give the number of yards in 1 pound of the yarn.

$$256,000 \div 6\tfrac{1}{4} = 40,960 \text{ yds. in } 6\tfrac{1}{4} \text{ dram silk.}$$

A less number of yards can be weighed, and the result multiplied by the divisor of the standard. For example:

500 yards is one-half of the standard and weighs $2\frac{1}{2}$ drams. $2\frac{1}{2} \times 2 = 5$ drams silk.

$256,000 \div 5 = 51,200$ yds. 1 lb.

100 yds. weigh .75 drams. $.75 \times 10 = 7.50$ or $7\frac{1}{2}$ drams.

$256,000 \div 7\frac{1}{2} = 34,133.3$ yds. 1 lb.

Spun silks are calculated by the same standard as cotton, 840 yards. 1 pound of 1's counts open silk.

The higher the numbers the greater number of yards to a pound.

Single 40's and two-fold 40's require the same number of hanks to the pound, and the two-fold is indicated in the opposite manner to the yarns $\frac{40}{2} = 40$'s.

Calculating for spun silks, the indicated counts would be considered; not the ply.

LINEN. COMBINED YARNS.

Linen yarns are reckoned the same as the cut system, woolen yarns. In fancy mills it is common to have several kinds of yarn woven in the same cloth, viz.: Cotton and Wool, Worsted and Wool, Worsted and Cotton, Cotton and Silk, Worsted and Silk. To find the equivalent counts, multiply the standard of the given thread by the counts, and divide by the standard of the required thread. What counts of woolen yarn, run system, equals a 30's cotton thread?

$840 \times 30 = 25,200.$

$25,200 \div 1,600 = 15\frac{3}{4}$ run woolen yarn.

What counts of woolen yarn, cut system, is equivalent to a $\frac{1}{20}$'s worsted yarn?

$$20 \times 560 = 11{,}200.$$
$$11{,}200 \div 300 = 37\tfrac{1}{3} \text{ cut woolen yarn.}$$

Any other combination of yarns can be found in the same manner as the above.

To find the counts of yarn that is on a beam, the weight and length being known.

Multiply the number of ends in the warp by the length, to get the total number of yards of yarn; divide by the weight multiplied by the standard of the yarn.

If 4,095,000 yards weigh 65 pounds, what is the counts?

$$\frac{4{,}095{,}000}{65 \times 840} = 75 \text{ counts.}$$

A stock warp is found, and the comparative weight of the beam is known, also the counts, what is the length of warp?

The beam and warp weigh 200 pounds., beam about 95 pounds and there are 2,780 ends on the warp, the counts is $\frac{2}{40}$'s worsted.

Multiply the yards in 1 pound of the given counts by the number of pounds of warp; and divide by the ends in the warp. The result will be the number of yards length of warp.

$$200 - 95 = 105 \text{ lbs. of yarn.}$$
$$\frac{11{,}200 \times 105}{2{,}780} = 423 \text{ yds. of warp.}$$

Suppose the number of ends in a warp is not known, but other data is known; to save the time of counting the threads the following rule can be applied.

Multiply the counts by the standard and the weight; then divide by the length.

A warp of 45 counts, 60 pounds in weight, 1,350 yards in length, what is the number of ends in the warp?

$$\frac{45 \times 840 \times 60}{1{,}350} = 1{,}680 \text{ ends.}$$

STOCK TAKING.

When taking stock it is the common practice to guess at the length of yarn there is on the beams, but to be more definite the

following rule can be followed. Subtract the number of pieces woven from the original number, multiply by the length, allowing for the approximate length of cloth on the roll, and the result will be the length of warp on the beams.

A warp originally had on it 60 pieces, 5 yards in length; 7 pieces have been woven, what is the length of the warp on the beams?

$$60 - 7 = 53. \quad 53 \times 54 = 2{,}862.$$

About 10 yards of cloth on the roll. $2{,}862 - 10 = 2{,}852$ yards.

The above is only the approximate length, but it is nearer than a guess, and a guess is likely to be a good many yards out.

What weight of warp would be required to make a warp of 90 pieces, 55 yards in a piece 2,440 ends in width, 40 cotton?

Multiply the pieces by the length of each piece and by the number of ends, divide by the number of yards in 1 pound of the given counts.

$$\frac{55 \times 90 \times 2{,}440}{40 \times 840} = 359.762 \text{ lbs. of yarn.}$$

Allowing 3 per cent waste in transferring the yarn,

$$359.762 \times 1.03 = 370.55 \text{ lbs. required.}$$

Whatever kind of yarn is being used, or the quantity required, the foregoing rule can be applied, using the approximate per cent of loss in transferring the yarn.

The sley means, the number of ends per inch in the reed, but often cloths are made with stripes in them that have more ends in each dent than the other portions of the cloth, and when calculating for the number of ends in the full width the average only is taken.

What are the number of ends and weights of yarn required in a warp as follows: $\frac{12}{4}$ that is 12 reed 4 in 1 dent 72″ in width, 424 yards in length, $3\frac{3}{4}$ woolen yarn?

Multiply the number of ends per inch by the number of inches in width, also by the number of yards there are in the length, to get the total number of yards of yarn there are in the warp. Divide the total number of yards of yarn by the number

of yards in 1 pound of the given counts of yarn. The result will be the weight of warp.

$$48 \times 72 = 3{,}456 \text{ ends in warp.}$$
$$3{,}456 \times 424 = 1{,}465{,}344 \text{ yds. in warp.}$$

$$1{,}465{,}344 \div 6{,}000 = 244.224 \text{ lbs. of yarn in the warp.}$$

A piece of cloth is required to be made as follows: A plain and satin striped cloth, 32″ in width aside from selvedges; plain stripe to be made $\frac{3}{4}$″ in width, 2 ends in 1 dent; satin stripe to be $\frac{1}{4}$″ in width, 4 ends in 1 dent, 40 reed. Selvedge to have 10 double ends in each side, and both edges of the cloth to be the same.

We have 125 pounds of 65's cotton yarn. What length of warp can be made from above particulars? Also give particulars for drawing the warp in the harness.

$$840 \times 65 = 54{,}600 \text{ yds. in 1 lb.}$$
$$54{,}600 \times 125 = 6{,}825{,}000 \text{ yds. total.}$$

$\frac{3}{4}$″ of a 40 reed would be 30 dents $30 \times 2 = 60$ ends of plain per inch.
$\frac{1}{4}$″ of a 40 reed would be 10 dents $10 \times 4 = 40$ ends of satin.
$100 \times 32 = 3200$. $3200 + 40 = 3240$ ends in the width.

$$6{,}825{,}000 \div 3{,}240 = 2{,}106.48 \text{ yds. of warp.}$$

Draw the plain stripe on the 4 harness and the satin stripe on the 6 harness.

Draw the selvedge, then commence the $\frac{3}{8}$″ of plain. Afterwards start with the full pattern $\frac{1}{4}$″ satin, $\frac{3}{4}$″ plain, and the finish will be the same as the commencement.

$60 \times 32 = 1{,}920$, $1{,}920 + 10 = 1{,}930$, $1{,}930 \div 4 = 482.5$ heddles.
$40 \times 32 = 1{,}280$, $1{,}280 \div 6 = 213.3$ heddles.

Place 483 heddles on each shaft for the plain and the 214 on each shaft for the satin.

TO FIND THE PRODUCTION OF A LOOM.

Multiply picks per minute by minutes in 1 hour, and by hours per day or week. Divide by picks per inch, then by inches per cut; the result will be the mathematical production; but the loom stops for change of filling, etc., so that the actual production will be less than the above; the loss can only be surmised until a test has been made, but let your aim be to get the highest production possible consistent with quality.

```
Speed for loom 168 picks per min.
                    60 min. per hr.
                 10,080
                     58 hr. per week.
Picks per in. 64)584,640
In. in 45 yds. 1,620)  9.135
                     5.638 cuts of 45 yds. in 58 hrs.
                     .850% of production, or allowing 15% for stoppage.
                     4.788 = Actual production per week.
```

TO FIND THE PER CENT OF PRODUCTION.

First find the mathematical production, then divide the actual production of the machine by the mathematical, and the answer will be the per cent of production.

```
Mathematical 5.5)4.35 actual production.
                 .79 = 79%.
```

To find the percentage of production when yards are considered ; substitute yards for cuts and proceed as above.

EXAMPLES.

If 6 looms produce 3,624 yards in 12 days, how many will 40 looms produce in 6 days?

There are two ways of obtaining the result required:

First: Find the average yards that one loom produces in the first case, then multiply the average by the second case.

```
                Yds.          Days.          Looms.
Example:  3,624 divided by 12 divided by 6 = 50.33 yds. in 1 day.

                Yds.    Days.  Looms.
                50.33 × 6 × 40 = 12079.20 yds.
```

Second Method: Proportion. Proportion is an equality of ratios. Ratios is the relation of one quantity to another of the same kind.

Place the number that is the same as the required answer in the third term, and if the question indicates that the answer ought to be larger than the third term, place the remaining terms with the larger one in the second place; then divide the product of the second and third terms by the first to obtain the fourth or answer.

Cancellation assists in the shortening of the sum.

In the example we require yards, and a greater number than

the third term, and as we have five sets of figures, to find the relation of one to the other, place them in this order.

Looms	to	Looms	
6	:	40	
Days	to	Days	$\frac{40 \times 6 \times 3{,}624}{12 \times 6} = 12{,}080$ yds.
12	:	6	
Yds.	to	Yds.	
3,624	:	x	

If 28 looms produce 1,400 yards of fancy cloth in 6 days of $10\frac{1}{4}$ hours per day, how many yards will 36 looms produce in 3 weeks, 58 hours per week?

First, reduce the days or weeks to hours.

$10\frac{1}{4} \times 6 = 61\frac{1}{2}$ hours. $58 \times 3 = 174$ hours.

Looms	to	Looms	
28	:	36	$\frac{9 \quad 200}{36 \times 174 \times 1{,}400} = \frac{9 \times 174 \times 200}{61.5} = 5092.68$ yds.
Hours	to	Hours	
$61\frac{1}{2}$	:	174	$61\frac{1}{2} \quad \times \quad 28$
Yds.	to	Yds.	7
1,400	:	x	

It is often necessary to produce a larger number of yards of cloth in a given time, so that small warps have to be placed in several looms to comply with the order.

Example:

Thirty pieces of worsted cloth, 60 yards in a piece, must be woven in 15 days. How many looms, and number of pieces to a loom, are required to weave the cloth in the given time?

One loom weaves 116 yards per week of 58 hours.

First find the number of yards per hour, then the length of time it takes one loom to weave one piece; divide the result into the time allowed, and the answer will be the number of pieces one loom can weave in the given time. Divide the total number of pieces by the production of one, and the result will be the number of looms required.

$116 \div 58 = 2$ yds. $60 \div 2 = 30$ hours to weave 1 piece.
$58 \div 6 = 9.7$ average hours per day.
$15 \times 9.7 = 145.5$ total hours.
$145 \div 30 = 4\ 85$ pieces produced by each loom in the given time.

It would be better under the circumstances to use 8 looms, placing 4 pieces in 7 looms and 2 pieces in one loom. This will allow time for accidents.

When a break-down occurs, note is taken of the length of time the loom or portion of it is stopped, and instead of sending in a report, that so many looms were stopped for so many hours, it is customary to divide the total number of looms in the room by the fraction of time that the looms were stopped, and the result will represent that so many looms ran the full time.

Example:

There are 580 looms in a room, and through a break-down the looms are stopped 4 hours, how many ran full time?

The working hours are 58 per week.

```
4)58                    14.5)580
  14.5                        40 looms stopped.

     580
      40
     540 looms run full time.
```

When looms are stopped for lack of weavers, the above rule can be applied, but a record ought to be kept of the reason why they are stopped.

To figure the pay per hour for odd help, whatever work they are performing: Divide the amount per week by hours of work: for several hours: multiply the rate per hour by the number of hours of labor.

A spare hand weaver is paid at the rate of $8.00 per week, and works $10\frac{1}{2}$ hours, what will be the price paid? Fifty-eight hours constitutes a week's labor.

```
58)$8.00
     13.79 cents per hour.
      10.5 hours of labor.
   144.795 = $1.44 per day.
```

Two days would be $2.89, three days $4.34, and so on: multiply the fraction of a cent each time.

Example:

An operative is paid $1.75 per day, and receives an increase of 5 per cent, what will be the wages paid?

There are two methods by which the amount can be computed. First, by finding what is 5 per cent of the wages already paid, and adding that amount: the sum will be the wages that has to be paid.

Second: Multiplying the amount paid by one plus the per cent.

```
  175          1.75
  .05            8
 8.75          1.83      $1.83 per day.
  175
 1.05
  875
175
183.75     $1.83 per day.
```

Suppose after a few months the same operative was reduced 5 per cent, will the former wages be paid? No.

```
  1.83          1.83
  .05             9
 9.15           1.74      $1.74 per day.
```

Or

```
1.05)1.83(1.74
     105
      780
      735
       450
       420
        30      $1.74 per day.
```

To find the per cent of reduction and increase, subtract the difference, divide this by the first value, and the result will be the per cent of reduction.

Example:

Ninety-five cents is paid for weaving a piece of cloth, the price is then reduced to 85 cents, what is the per cent of reduction?

```
   95
   85
95)10.0(.105      10½% reduction.
   95
    500
    475
     25
```

Reduced from 25 cents to 23 cents.

```
   25
   23
25) 2.00(.08      8% reduction.
    200
```

Increased from $1.56 to $1.62.

```
      1.62
      1.56
1.62) .0600(.037      About 3¾%.
       486
       1140
       1134
          6
```

TO FIND THE COST OF PRODUCTION.

1. A spare hand weaver receives $8.50 per week, and produces 825 yards from 5 looms, what is the cost per yard?

$8.50 ÷ 825 = 1.03 cts. per yd.

2. A weaver is paid $8.50 for producing 15 pieces of cloth each 55 yards in length, what is the cost per cut?

$8.50 ÷ 15 = 56⅔ cts. per cut.

3. A weaver produces 240 yards of cloth and has to receive $5\frac{1}{2}$ cents per yard, what is the amount paid?

240 × .055 = $13.20.

Or for each piece of 40 yards, $2.20. 40 × .055 = $2.20.

4. A loom produces in one week, three pieces of 45 yards in each piece, total 155 yards. 85 cents is paid for each piece, total cost $2.55, what is the cost per yard?

255 ÷ 155 = 1.65 cts. per yd.

Cost Per Pound.

A weaver has four looms, each loom has a different pattern in it, with prices paid in proportion, as follows:

1. Leno striped cloth, 50 yards in length of cut, 73 cents per cut; weight, 5.09 yards per pound; average 4 cents per week.

2. Bedford Cord. 50 yards in length of cut, 70 cents per cut; weight, 3.19 yards to the pound; average 3.5 pieces per week.

3. B. C. Leno. Length of cut 70 yards, $1.38 per cut; weight, 4.20 yards per pound; average 3 pieces per week.

4. Fancy Mercerized Stripe. Length of cut 70 yards, $1.30 per cut: weight, 4.07 yards to the pound; average 3 pieces per week.

What is the cost per pound in each case?

	Yds. in Cut		Yds. in 1 Lb.	
1.	50	÷	5.09	= 9.82 lbs. in 1 cut of 50 yds.
	Cents			
	73	÷	9.82	= 7.44

or expressed in cost of cts. per lb. the answer would be $.0744 per lb.

	Yds. in 1 Cut		Yds. in 1 Lb.	
2.	50	÷	3.19	= 15.67 lbs. in 1 cut of 50 yds.
	Cents			
	70	÷	15.67	= 4.46 or $.0446 per lb.
	Yds. in 1 Cut		Yds. in 1 Lb.	
3.	70	÷	4 20	= 16.67 lbs. in 1 cut of 70 yds.
	Cents			
	138	÷	16.67	= 8.27 or $.0827 per lb.
	Yds. in 1 Cut		Yds. in 1 Lb.	
4.	70	÷	4.07	= 17.19 lbs. in 1 cut of 70 yds.
	Cents			
	130	÷	17.19	= 7.56 or $.0756 per lb

To find the percentage of warp and filling in a piece of cloth. proceed as follows, using cloth No. 1 as an example: 102 threads per inch; 64 picks per inch; 27 inches in width. 30's warp; 40's filling; 50 yards in length.

To find the amount of warp yarn.

Threads per In.		In. Wide		Length in Yds.	
102	×	27	×	50	= 137,700 yds. of warp.

To find the amount of filling.

Picks per In.		In. Wide		Length in Yds.	
64	×	27	×	50	= 86,400 yds. of filling.

Or $64 \times 27 \times (36 \div 36) \times 50 = 86{,}400$ yds. of filling.

Add together the total weights of warp and filling, and divide the separate amounts by the sum of the addition; the result will be the percentage of each.

137,700 $\quad$ $137{,}700 \div 224{,}100 = .6144 = 61.44\%$ of warp.
86,400
224,100 lbs. of yarn. $\quad$ $86{,}400 \div 224{,}100 = .3855 = 38.55\%$ of filling.

To find the weight of warp and weight of filling in cloth No. 1.

Multiply the weight of a cut of cloth by per cent of warp to find the weight of warp; then subtract the weight of warp from the weight of the cut, and the result will be the weight of the filling.

$9.82 \times .6144 = 6.033408$ lbs. of warp or $6\frac{3}{100}$ lbs. of warp.
$9.822 - 6.033408 = 3\ 788592$ lbs. of filling or $3\frac{3}{4}$ lbs. of filling.

The amount of filling required per day is in proportion to the number of yards woven in one day, and can readily be estimated.

If a third of a cut is woven in one day,

$$3\tfrac{3}{4} \div 3 = 1.25 \text{ lbs. of filling.}$$

To find the cost of yarn, both warp and filling, in cloth No. 1. 30's warp cost 21 cents per pound. 40's filling cost 23 cents per pound.

Weight of warp yarn,

$$6.033 \times 21 \text{ cts.} = 126.693 \text{ or } \$1.26\tfrac{2}{3}.$$

$$3.786 \times 23 \text{ cts.} = \frac{87.078}{213.771} \text{ or } \frac{\$\ .87}{\$2.13\tfrac{3}{8}} \text{ total cost.}$$

To find the amount of cloth a given quantity of filling will make, other data known.

Cloth No. 1. If $3\tfrac{3}{4}$ lbs. of filling will make 50 yards of cloth, how many yards will 20 pounds make?

Lbs.		Lbs.		Yds.		Yds. Required
3.75	:	20	: :	50	:	x

$$\frac{20 \times 50}{3.75} = 266.6 \text{ yds. of cloth.}$$

It is a well-known fact that 70 yards of warp yarn will not make 70 yards of cloth, owing to the interlacing of the warp yarn with the filling; so that when figuring out the length of cloth required, the shrinkage of the warp must be taken into consideration. The amount of shrinkage or take-up can only be determined by actual practice, but approximate shrinkage can be determined by measuring a length of woven yarn.

Example: Cloth No. 1 on which two warps were used.

Warp No. 1. 2,456 ends $\frac{1}{30}$'s 6% shrinkage.
Warp No. 1. 156 ends $\frac{2}{20}$ 15% shrinkage.

Twenty pieces of 70 yards each were woven, what was the actual length of both warps?

Yds.

$70 \times 1.06 = 74.20$ yds. in each cut.
$74 \times 20 = 1{,}480$ yds. on the warp.
$70 \times 1.15 = 80.50$ yds. in each cut.
$80.50 \times 20 = 1{,}610$ yds. on the warp.

To find percentage of size added to the warp yarn.

The weight of the yarn before it is sized can be ascertained by the usual method: Multiply the number of ends by the length,

and divide by the number of yards in 1 pound of the given counts; add to the answer the weight of the beam. Subtract the final result from the weight of a warp doffed from the slasher; the difference will be the amount of size that has been added. To find the per cent proceed as follows:

A warp is made of 3,500 ends, 1,200 yards 60's cotton.

The warp weighs 135 pounds after it has been sized, the empty beam weighing 48 pounds. What percentage of size has been added to the yarn?

Ends in Warp		Yds	
3,500	×	1,200	= 4,200,000 yds. total.
Yds.		Counts	
840	×	60	= 50,400 yds. in 1 lb.
4,200,000	÷	50,400	= 83.33 lbs. of unsized yarn.
Lbs.		Lbs.	
135	—	48	= 87 lbs. of sized warp yarn.
87.00			
83.33			
3.67	difference		3.67 ÷ 83.33 = .044 or $4\frac{4}{10}$%.

Or

```
        87.00
        83.33
        ------
         3.67
          100
83.33)367 00
      ------
        4.4
```

$4\frac{4}{10}$% size added to the warp.

Speed and gear calculations are found in another section.

There are several reports and order sheets in connection with the weave room: The first one is an order sheet as follows: and is passed to the Overseer from the Superintendent.

THE ISA MANUFACTURING CO.

No. 1.

Ordered 5 *Mo.* 10, *1902*

Mr. Smith *Overseer* Weave *Room*

Style No. 1,892 *Sample No.* 1,910

Total pieces 2,000 *Weekly delivery* 150 *Delivery begins* June 4

Reed 24 *Pick* 80 *Aver Sley* 96 *Aver Pick* 80

Width in Reed 30 *Width of Cloth* 28

No. Ends 1,773 *Counts Warp* 36 *Yds. in Cut* 70

" 342 " " 2-40

" 114 " " 2-20

" " "

Counts Filling 20 *Aver No.* 21

Yds. per lb. 407 *Speed* 175

Prod. per doz. yds. 25 *Lbs.* 6.14 *Per cent* 75

Weave Mere Stripe

Price per cut 130

Remarks

If necessary change 2,630 to get this out on time.

J. HARRIS, Supt.

THE ISA MANUFACTURING CO.

No. 2.

Ordered . . . . . 5-10-190?

Style	1892	
Slasher No.	2	
No. Yarn	36	
Section Beams	4	443
		443
		443
		444
Spools		
Total Ends		1773
Length of cut	70	
Gear	26	
Color of Mark	Red	
No. of Filling	20	
Price Drawing	$1.15	
No. of Cuts	2,000	
No. of Warps	80	

Finished June 26, 1902.

WEAVE ROOM REPORT.

Week ending.....

No. 3.

No. of Looms.	Weaver's Name.	Style.	No. of Cuts. Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Total.	Price per Cut.	Total.	Charges Seconds.	Spare Hand.
1.		2,630		1–1 / 1–19			1–1 / 2021		4	.73	$2.92		
2.	Mary Todd	2,160	1–1 / 11.12			1–1 / 13.14			4	.70	2.80		
3.		1,960	1/9		1/10			1/11	3	1.38	4.14		
4.		1,892		1/4		1/5		1/6	3	1.30	3.90		
5.													
6.													

BRADFORD DURFEE COLLEGE LIBRARY

WEAVE ROOM.

SEPT. 22, 1902.

No. 4.

Section No. 1.

Take off looms on style 2,630.
Put on 6 looms on style 1,960.
Weave; mercerized stripe.

Width in reed	30½″
Width in cloth	28
Picks	81
Gear	40
Filling	40
No. harness	16
No. beams	3
Size of pulley	14½″

Remarks:

Bring a sample yard and a small piece into the office.

J. SMITH, *Overseer.*

THE ISA MANUFACTURING CO.

REPORT OF

WEAVING DEPARTMENT.

No. 5. For the week ending June 4, 1902.

			Time	Production	Price	Amount	
1.	Overseer	1	day	6	$4.00	$24.00	$24.00
2.	Second Hands	2	hour	58	27.68	16.00	32.00
3.	Fancy Fixers	18	hour	58	.25	14.50	116.00
4.	Plain Fixers	4	hour	58	23.45	13.60	54.40
5.	Change Fixers	2	hour	58	18.96	11.00	22.00
6.	Smash Piecers	2	hour	58	17.67	10.25	20.50
7.	Filling Tenders	2	day	6	1.25	7.25	14.50
8.	Filling Tender	1	hour	58	11.379	6.60	6.60
9.	Laborer	1	day	6	1.25	7.25	7.25
10.	Scrubber	2	hour	58	10.34	6.00	12.00
11.	Oiler	1	hour	58	12.93	7.50	7.50
12.	Cloth Booker	1	hour	58	14.65	8.50	8.50
13.	Weavers' Spare Hands	6	hour	58	17.068	9.90	59.40
14.	Total						$384.65
15.	Weavers' Allowance		hour	29	17.068	4.95	4.95
16.	Pounds Woven			64,141		Cost	2,372.30
17.	Total Cost						$2,761.80
18.	Cost per lb.				.0430		
19.	Cost of Weaving per lb.				.0369		

Pounds Soft Waste	63
Pounds Hard Waste	
Pounds Sweepings	80

No. 2 is given to the overseer of the dressing room, which states the particulars necessary for him, namely: Number of warps; cuts on each warp; slasher length of each cut, or gear, owing to the length of yarn being larger than the cloth length.

No. 3 shows the form of a weave room report, which is exposed in some convenient place, generally near the cloth board.

The small figures represent small paper checks that the weavers are supplied with to sew on the cloth, and which indicate one or more pieces; the checks are numbered, the number acting somewhat as a remedy against mistakes.

Charges mean money deducted for second quality cloth, and loss through non-attendance at work.

A red mark is generally placed alongside the particular piece of cloth that is considered as seconds. Also the weavers who are not up to the average in production have a mark attached to their names.

No. 4 shows an order that is handed to the second hand by the overseer and explains itself.

No. 5 summarizes the cost of odd help, and under the head of miscellaneous cost is balanced with the cost per pound for weaving.

Item 14 on this sheet gives the total cost of miscellaneous help.

Item 15 is the sum allowed to a weaver who had a poor weaving warp in the loom, or it is sometimes charged as pattern weaving.

Item 16, pounds of cloth woven and the cost.

Item 17, the total cost of producing the cloth in the weave room.

Item 18, the cost per pound, obtained by dividing item 17 by pounds woven.

Item 19 is obtained by dividing cost of weaving by pounds woven; both items under item 16.

TO FIND THE COST OF PRODUCTION IN THE WEAVE ROOM.

Competition is so keen that it is necessary to know the cost of production of each yard of cloth, and the only way to find that

cost is to summarize the production and the cost, then balance one against the other.

No. 6.

SUMMARIZED LIST.

1.	Number of looms running		371
2.	Number of pieces woven		2,218
3.	Number of yds. woven		114,396
4.	Number of lbs. woven		15,094
5.	Number of yds. per loom		308
6.	Number of lbs. per loom		40½
7.	Average number of weavers on each style		46.38
8.	Average number of lbs. to a weaver		326
9.	Cost of weaving	$439.16	
10.	Miscellaneous cost	57.97	
11.	Cost of weaving per lb.		.0291
12.	Miscellaneous cost per lb.		.0038
13.	Total cost of production		.0329
14.	Total cost of production	$497.13	

Items 1, 2, 3, 4, 8 and 9 explain themselves, and are necessary to find the answer to the remaining items. To find the yards per loom, divide the yards woven by number of looms running; to find the number of pounds per loom, divide item 4 by item 1; to find the cost of weaving per pound, divide the cost of weaving by the number of pounds; to find the miscellaneous cost per pound, divide the miscellaneous cost by number of pounds; to find total cost add items 9 and 10. The miscellaneous item means the cost of all odd help, such as fixers, filling carriers, scrubbers, oiler, cloth booker, laborer.

To find the average number of weavers on each style, divide the number of looms running on that style, by the number of looms to a weaver.

To find the number of pounds to a weaver, divide the number of pounds of that style by average weaver.

No. 6 is computed from Nos. 3 and 5, but the items from No. 3 are first classified in a book kept for the purpose, which will show so many looms weaving style 2,630. There is also a separate account kept of persons employed and wages paid.

Mills have different systems, but the foregoing show one method of keeping the weave room accounts.

Instruction sheet No. 7 and report sheets Nos. 8 and 9, are generally used in a woolen and worsted mill with slight changes in methods.

Report sheet No. 8 is the one used in the weave room, and indicates to the weaver how much cloth has been used.

In worsted mills and generally in woolen mills, the piece is marked down instead of the number of yards per half day as shown on this sheet. These sheets are generally made to cover one month's work.

No. 9 is the report of one week's production in the weave room.

BANHUC MANUFACTURING CO.

INSTRUCTIONS FOR MANUFACTURING STYLE. 27″ TRICOT PATTERN, 1,673.

No. 7.

Threads in warp	2,430	Length from loom per piece	40
Ends per in. finished	30	Finished length of piece	39-38
Size of warp	$5\frac{3}{8}$	Finished width of piece	27″
Reed	$\frac{2}{13}$	Finished weight per yd.	2.7
Inches wide in reed	30		
Picks of filling	26		
Size of filling	$4\frac{7}{8}$		
Weight from loom per yd.	8.5		

Remarks:

$1.85 for 80 yds. 14 pieces per week.

BANHUC MANUFACTURING CO.

WEAVING.

No. 8.

Pay No.	Date	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Amount
58	Time	$10\frac{1}{2}$	$10\frac{1}{2}$	$10\frac{1}{2}$	$10\frac{1}{2}$	$10\frac{1}{2}$	$5\frac{1}{2}$	
	Style 27/300							
Loom No. 1-2								
	Yds.	38	40	40	39	38		
		39	38	40	38	38	39	
1	Price	1.85	1.85	1.85	1.70	1.70	.85	$9.80

BANHUC MANUFACTURING CO.

WEAVING.

No. 9.

Hours worked, 58. Waste lbs. Per cent waste.

Width	Style	Looms	Cuts	Pieces	Pounds	Yards	Aver Oz.
35	2,402	7	19	38	$771\frac{1}{4}$	$2,130^{2}$	5.8
27	300	44	206	618	5,101	$24,699^{3}$	3.3
32	184	2	4	8	84	315^{2}	4.3
27	550	47	222	666	$5,518\frac{1}{4}$	$26,559^{2}$	3.3
36	179	1	5	10	161	361^{2}	7.0
		101	456	1,340	$11,635\frac{1}{2}$	$54,066^{\frac{3}{4}}$	

HUMIDITY IN THE WEAVE ROOM.

Humidifying the atmosphere is of two-fold value; each value will be taken separately. First, it is a well-known fact that filling requires to be conditioned, that is, passed through a moistening process before it will weave acceptably: as this is true of filling more particularly is it true of warp yarn after it has been sized.

While the sizing compound is expected to lay the fibres to a greater or less extent, the necessity of drying the yarn before it passes on to the beam, takes out the natural moisture from the fibre, causing the yarn to be more or less brittle, destroying somewhat the elasticity of the yarn. The retention or loss of elasticity means, the retention or loss of brightness or lustre to the yarn; consequently the product will not have the bright appearance and finish that is absolutely necessary in a good piece of cloth, if the elasticity is taken out. To condition and bring the warp yarn as near as possible to natural conditions, so that the production may be of the best both as to quality and quantity, what has to be done? The room must be kept in such a condition, especially on dry days, so that there is sufficient moisture in the air to somewhat penetrate the size on the yarn, and in this way condition the fibres, actually strengthening them for the work they have to do.

The extent to which the air in a room is moistened is termed relative humidity, which means the amount of moisture in the air as compared with the amount the air would contain if it was thoroughly saturated; and when the temperature of the room is lowered with the same amount of moisture in it, the moisture in the air would be condensed and settle on the machines. Heating the room with the same amount of moisture in the air would have the opposite effect, making what is termed a dry atmosphere.

It is to overcome this dry atmosphere and regulate the humidity of the room, that the "Air Moistening System" has been brought to such a state of perfection, and by the use of such a system as shown in Fig. 138, the relative humidity can be so arranged and controlled, that the best results can be obtained.

Second, from the standpoint of a room that is dry and charged with electricity. It is a well-known fact to mill men in general, that the humidity of a weave room materially affects the production of the loom; the friction from the belts generates electricity

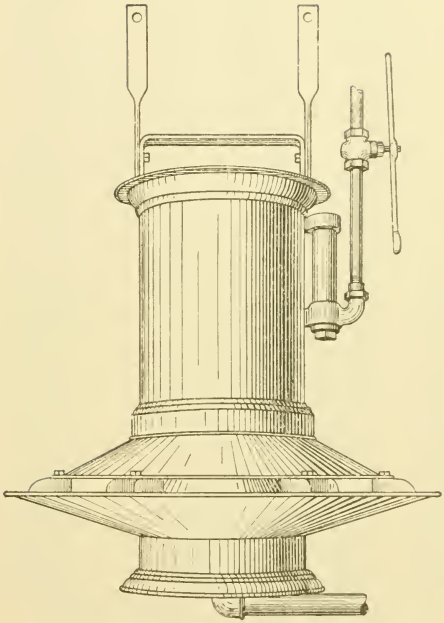

Fig. 138. Humidifier of the American Moistening Co

to such an extent that the atmosphere becomes dry, and this dryness acts in such a manner on the yarn that the fibres open out and the yarn becomes beardy or hairy; the yarn loses in strength and in addition will not weave as well as it should; the threads not only cling together in the shed, preventing a clear open space for the shuttle to pass through, but as they pass between the leese rods the loose fibres work out from the yarn and form in bunches on the yarn; often two or more threads will be fixed together by these bunches and when they weave up to the harness one or more of them will break out. In addition, if the bunch happens to work through the heddle to the reed, the oscillations of the reed cause more loose fibres to gather with the already large bunch, the only result possible being, the thread breaks out, the bunch prevents the thread from working out to the back of the harness, so clings in the shed, makes a pick out, and will sometimes throw the shuttle. This means loss of production, also poorer quality of production, and the faults do not end here; it is utterly impossible for the workers to use the same energy when the air is dry as when a fair amount of moisture is in the air. Too much moisture is almost as bad as too little, for everything becomes damp and sticky, the weavers are always complaining that they have colds and other kindred ailments. Such elements certainly are not conducive to good results.

Various mills have different systems for humidifying the atmosphere: some still cling to the old method of allowing steam to escape through traps fitted in the floor, but happily they are becoming more rare, for the steam pipes tended to cause excessive heat at times which killed whatever value there was in the steam. In addition, there always seemed to be an accumulation of lint around the trap, and the floor and machinery for quite a space around never seemed clean.

Fig. 139 shows very clearly the advantage gained from the use of this system; the open fuzzy strand was photographed during the time that the percentage of moisture was very small; the air being what is commonly called in a dry state. The close strand with little if any fuzzy fibres was photographed after the moistening system had been installed, which conclusively proves the value of this system in obtaining relative humidity.

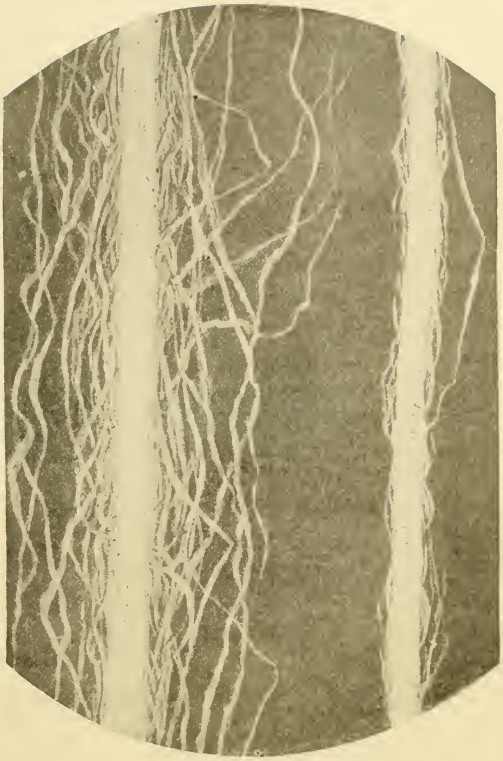

Fig. 139. Yarn Spun With and Without Humidifier.

The instrument for measuring the degree of relative humidity is in the form of a double thermometer, technically called hygrometer: to one there is connected a wet bulb; a wick attached to this and resting in a small quantity of water is so influenced by the atmosphere as to register on the hygrometer the degree of humidity. As the air becomes dry the moisture surrounding the wick is absorbed, thus lowering the indicated temperature in that thermometer, incidentally indicating the difference in the humidity of the room. If there was no evaporation from the wet bulb, it would indicate that the air in the room was thoroughly saturated and both thermometers would read the same.

EXAMINATION PAPER

WEAVING.

PART III.

Instruction to the Student. Place your name and full address at the head of the paper. Use any cheap, light paper like the sample already sent you, of a size about 7 by 9 inches. Study the Instruction Paper thoroughly before attempting to answer the Examination, and then answer in *your own words.*

1. If ten looms produce 6,500 yards in 11 days, how many yards will 35 looms produce in 9 days?

2. What is the actual length and weight of warp yarn in the following pieces of cloth? Mercerized and fancy stripe, 32 reed, fancy 4 in 1 dent, mercerized 2 in 1 dent, $31\frac{1}{4}$ inches in the reed, spaced 1 inch of fancy $\frac{3}{8}$ inch of mercerized, finish with 1 inch of fancy, making 23 spaces of fancy, 22 spaces of mercerized; 30 pieces of cloth 45 yards in length; mercerized stripe takes up $3\frac{1}{2}$ per cent, fancy stripe 4 per cent. Fancy stripe 40's cotton, mercerized $\frac{2}{20}$'s.

3. If the filling in the cloth has a tendency to drag at the sides as it passes over the breast beam, how would you remedy the fault?

4. What is the production of a loom running 180 picks per minute, 58 hours per week, 72 picks per inch? Allow $12\frac{1}{2}$ per cent for stoppage.

5. Suppose the loom was continually stopping without the filling breaking, what method would you pursue to find the cause?

6. Name at least 10 causes of shuttle flying or jumping out, and explain how they cause the result.

7. A weaver is paid $8.30 for producing 19 pieces of cloth, each 48 yards in length; what is the cost per piece and yard?

8. Suppose the warp yarn was being broken continually in the same place, what would you consider the cause?

9. What weight of warp yarn would be required to make a warp of 80 pieces, 48 yards in a piece, 2,360 ends in width, 35's cotton? Allow 3 per cent waste.

10. If you had a loom making cockly or uneven cloth, where would you look for the cause?

11. A weaver produces 280 yards of cloth, and receives $5\frac{1}{4}$ cents per yard, what is the amount received?

12. If you had a loom making thick and thin places, how would you remedy the fault? Friction let-off.

13. Give the standard numbers for the following kinds of yarn: cotton, wool run and cut systems, worsted, linen, spun silk, raw silk.

14. What weight of yarn would be required in a warp as follows: summer overcoating, 8 harness satin back, cassimere twill face, 18 reed, 6 ends in 1 dent, 56 inches in width, $\frac{2}{40}$'s gray and black twist worsted, 50 threads each side for selvedge $\frac{2}{40}$'s black worsted? Warp to be 290 yards in length.

15. Give six causes of uneven cloth from the gear let-off.

16. If 120 yards of cotton yarn weigh 16 grains, what is the counts?

17. If 30 yards of cotton yarn weigh $7\frac{1}{2}$ grains, what is the counts?

18. If a half yard of cotton yarn weighs $\frac{1}{3}$ of a grain, what is the counts?

19. What effect would a broken beam flange have on the cloth?

20. Give all the particulars for the following piece of cloth such as: drawing in draft, pegging plan, number of heddles on each shaft, weight of warp and filling yarn, both in single piece and whole warp, cost of weaving per yard, piece, and total number of pieces. 30 inches in the reed, 46 reed, cotton 2 ends in 1 dent, silk 6 ends in 1 dent; the stripes to be 2 inches of plain, $\frac{1}{2}$ inch of silk, have stripes near the selvedges the same; cotton warp 90's counts, silk warp 2 drams, silk filling 12-14 deniers; allow 2 per cent take-up for cotton warp, $1\frac{1}{2}$ per cent silk warp, and $1\frac{1}{4}$ per cent filling. 15 pieces 50 yards in length; 75 cents per piece. Cotton stripe plain, silk stripe 8 end satin.

21. What is the counts of the combined threads, 40's, 30's, 25's?

22. What is the counts in run system and length of 75 pounds of woolen yarn; 50 yards weigh $42\frac{1}{2}$ grains.

23. If a loom produces 230 yards of cloth per week, for which $10.35 is paid, what is the cost per yard?

24. What is the weight of 12,600 yards of $\frac{2}{36}$'s worsted?

After completing the work, add and sign the following:

I hereby certify that the above work is entirely my own.

(Signed).

SOUTHEASTERN MASSACHUSETTS UNIVERSITY
3 2922 00321 390 4

Date Loaned

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American School pt. III
(Chicago, Ill.)
Weaving

pt.3